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Tool setting

Problem

Before machining a component it is essential that the machine tool contains correct length and diameter information for each of the cutting tools to be used to complete the cutting program.

Offline methods of setting tools rely on external measurements and a transfer of tools and data into the machine tool. As measurement is made with the tool in a different clamping condition to that used for cutting, a systematic error may be introduced between the measurement system and machine tool.

Several other errors may also be introduced using an external tool-setting process:

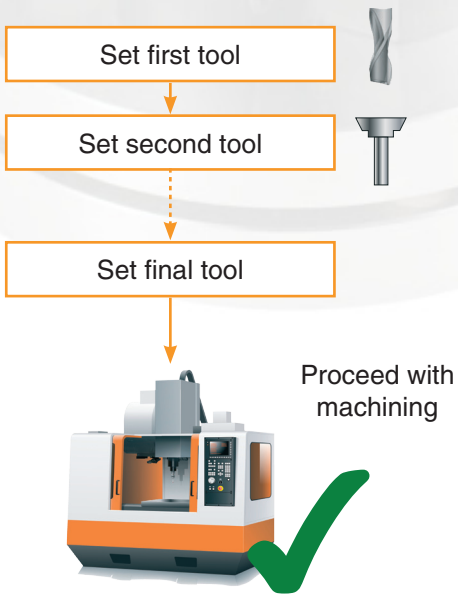
- Where a manual calculation or data transfer is required, an incorrect calculation, transposition of data, or an offset value mistakenly loaded can cause significant deviation from the expected result: a particular risk when operators are working under time pressure
- Operator skill and consistency can cause a variation in the level of control being applied. For example, where a minor update may be insignificant with respect to a much larger part tolerance, some operators may choose not to adjust the tool offset
- Manual transfer of tools from an offline measurement device may result in damage to fragile tools, or tools being mistakenly loaded into the wrong location of the tool carousel

Manual setting of a tool also introduces a time penalty for subsequent operations:

- Downstream processes must be designed to cope with any variation in the accuracy of initial tool set-up. Where tools are only approximately measured, an excessive amount of stock must remain on the component prior to finishing operations or it may result in unnecessary air-cutting operations
- The ability to manually set tooling may be limited by the number of skilled operators available: delays on each component whilst ‘awaiting set-up’ may become significant if sufficient operators are not available

Solution

Use a tool setting probe mounted within the machine tool to automatically set the length and diameter of each tool before machining begins.



Benefits

- Eliminates manual set-up operations, giving a consistent and accurate result
- Subsequent operations can be designed to work with reduced variation
- Cycle time becomes much more predictable since the machine is no longer “waiting for operator”

Case study

A table-mounted TS27R tool setting probe installed on a vertical machining centre sets tool lengths for a variety of ball cutters used to produce high quality plastic mould and pressure die-cast tools. The tool setting probe allows cutting tool measurement to take place on the machine, accounting for thermal and clamping effects. Using the tool setting probe in conjunction with a spindle mounted probe (see AP301 ‘*Cutter parameter update*’), the machining centre achieves very high accuracy, rapid machining with repeatability better than 10 µm.

Fast and accurate on-machine tool setting gives consistent results and takes into account thermal effects

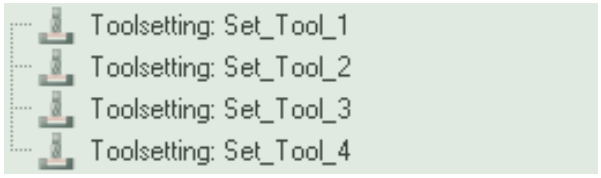
Advanced application

It may prove beneficial to use pattern AP205 (Tool identification) to detect any problem with the build of tooling, or an incorrect build-up of the tool itself.

On-machine tool setting does not take into account any variation in cutter performance experienced when cutting. To compensate for this variation and to ensure a more accurate result for a specific process, consider applying pattern AP301 (Cutter parameter update) which uses a spindle probe measurement to ‘fine-tune’ a specific cutter parameter based on real dimensional data.

Example 1: setting a tooling suite: set tools 1 to 4 on a contact tool setter

Sample Productivity+™ probe software program



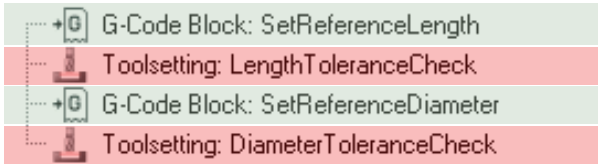
Single tool setting for each tool required for the machining program: 1 to 4.

Sample Inspection Plus software program

T1 M06	
G65 P9857 T1	Measure tool length and update tool offset 1
T2 M06	
G65 P9857 T2	Measure tool length and update tool offset 2
T3 M06	
G65 P9857 T3	Measure tool length and update tool offset 3
T4 M06	
G65 P9857 T4	Measure tool length and update tool offset 4

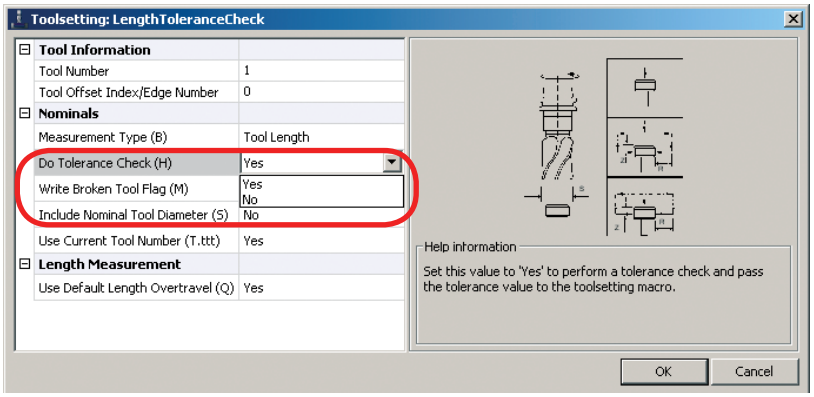
Example 2: setting a tool and performing a tolerance check

Sample Productivity+™ probe software program



Tool reference length and diameter written to available variables.

Recorded tool dimensions checked to determine if within allowable tolerance values (see dialog below).



Sample Inspection Plus software program

T1 M06	
G65 P9857 T3 D40 H0.1	Measure 40 mm diameter tool and update offset 3 with a tolerance of 0.1 If out of tolerance then no update takes place

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- **Styli for CMM and machine tool probe applications.**

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